OPEN-CELLED PAVERS: AN ENVIRONMENTAL ALTERNATIVE TO TRADITIONAL PAVING MATERIALS

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INTRODUCTION

Replacing traditional impervious paving materials with porous pavements such as open-celled pavers is one method that site designers can use to negate the harmful environmental impacts of land development upon surface streams and waterbodies. Due to their porous nature, open-celled pavers can reduce the volume and rate of stormwater runoff when compared to impervious paving materials. Also, because they allow stormwater to infiltrate the soil, they have the capability of filtering pollutants from the stormwater runoff that would otherwise be discharged directly into surface streams. Unfortunately, many site design professionals are hesitant to utilize these pavers on site development projects due to a perceived lack of quality in the visual appearance of pavements composed of these pavers. Current research is underway at the University of Georgia to identify the brands of open-celled pavers and varieties of turfgrass that are best for use in this part of the United States.

BACKGROUND

Uses of Pavers

Open-celled pavers are designed to allow turfgrass or other plant materials to be grown in locations where they would not normally be expected to survive. Various companies manufacture these pavers from either concrete or plastic. The specific size, shape, and material of the different brands of open-celled pavers varies by the manufacturer -- no two brands of pavers are identical. Regardless of the specific manufacturer, the function of the different brands are the same. The body of the paver protects the plants from compaction, erosion, and abrasion, while the open cells provide a porous medium for plant growth. Thus the use of these pavers on development sites allows a porous pavement surface to be installed in locations where impervious materials such as asphalt or concrete would normally be used.

The primary intended use of these pavers is for low intensity vehicular areas such as overflow parking for office parks, shopping malls, apartment complexes, or even guest parking at single-family residences. In these locations, the pavement is usually not exposed to heavy traffic use on a daily basis. In many instances, the paving may be used only once or twice per week.

Open-celled pavers are also commonly used on golf courses for cart paths or to provide parking for golf carts adjacent to tee boxes and greens. They may also be used to stabilize the soil surface around buildings and along the shoulders and ends of airport runways. In these locations, the pavers prevent vehicles from becoming mired in soft soil in case access by emergency vehicles is required.

Open-celled pavers are also frequently used to line drainage swales and streambanks. In these instances, the pavers protect the turfgrass or other plant materials from the erosive force of the moving water until the plants are well established. Once the plantings are established, they have the capability of slowing the velocity of stormwater runoff as well as providing filtration of sediments and other pollutants that would otherwise be transported to adjacent streams.

Causes of Low Usage

In spite of the fact that the use of these pavers can provide a beneficial influence on the quality and quantity of stormwater runoff, they are currently receiving little use from site design professionals like civil engineers and landscape architects. An uncertainty among the design professions about the performance and appearance of paving surfaces composed of these pavers is one possible reason for the lack of use.

In theory, turfgrass grown within the cells of these pavers looks as good as that grown anywhere else on the project site. The reality is that turf grown within the paver cells rarely looks as good as the paver manufacturers promise it to appear in their promotional brochures. To absorb the weight of vehicular traffic, open-celled pavers are typically installed upon one or more courses of granular aggregate. While these aggregates are effective in transmitting vehicular loads, thus preventing compaction and allowing stormwater infiltration, they are not so good for growing quality stands of turf. Water and nutrients are quickly lost from the root zones of the plants. Thus the turf becomes more susceptible to nutrient deficiencies and drought during the summer and to freeze damage during the winter.

PREVIOUS RESEARCH

Very little previous research has been conducted upon these pavers. About ten years ago, researchers determined that open-celled pavers had the capacity to greatly reduce the runoff coefficient of a pavement surface when compared with an impervious paving material. Further, that study found that the open-celled pavers reduced the levels of ten pollutants commonly found in urban area runoff (Day et al,1981).

Another study documented that the air temperature above the surface of a pavement composed of these pavers tended to be lower than that above a pavement composed of asphalt concrete (Smith et al, 1981).

No research to date has evaluated differences in the physical appearance of pavements composed of the various brands of open-celled pavers and varieties of turfgrass, yet this is an area that is critically important to site design professionals. Only one report has been found that compared the appearance of different varieties of turfgrass when used in conjunction with one brand of paver (Shearman et al, 1980). And only one reported study compared different brands of pavers. In that report, researchers found that infiltration rates varied with the different brands of open-celled pavers (Day, 1980), but did not attempt to compare differences in physical appearance.

Perhaps another reason for the lack of use of these pavers is that planning and engineering professionals concerned with developing Best Management Practices for stormwater management have failed to consider the possibility of including these pavers as a possible BMP. Thomas Schueler, in a highly-regarded summary of stormwater management alternatives, considers only porous asphalt in his discussion of porous paving as a BMP, and completely ignores the potential of open-celled pavers as an alternative (Schueler, 1987).

METHODOLOGY

A series of plots composed of six different brands of open-celled pavers was established in the spring of 1992 at the University of Georgia's Soil Testing Lab property. Six plots, each approximately 10' x 10' in surface area, were installed for each of the six different paver brands. Funding for the project was obtained from the University of Georgia Research Foundation, while the pavers themselves were donated by the paver manufacturers. The pavers were all installed according to the individual manufacturers' recommendations for use under a low traffic application.

The pavers were grassed with six different varieties of turfgrass that are commonly available and widely used on landscape development projects in Georgia. After a three-week period of establishment, supplemental irrigation to the plots was suspended. The plots were maintained under a low intensity of culture during the summer and early fall of 1992. The lowered level of culture attempted to simulate actual maintenance levels on many site development projects in which these pavers might be used.

In October of 1992, approximately six months after the plots were installed and grassed, evaluations were conducted by twenty-four landscape architects in the Athens area. Evaluators included faculty members of the School of Environmental Design, graduate students of the School who possessed undergraduate degrees in landscape architecture, and professional practitioners in the Athens area. Evaluators were asked to assign a score to each of the thirty-six plots, based solely upon their consideration of the physical appearance of each plot. The purpose of this study was to attempt to identify brands of paver and varieties of turfgrass that, when used individually or in combination, would yield the best physical appearance.

CONCLUSIONS AND RECOMMENDATIONS

Results. Results of the evaluations found that there are perceived differences between the various brands of pavers as well as between the different varieties of turfgrass in terms of physical appearance. Evaluators were asked to score each plot on a scale of 0 (lowest) to 4 (highest).

Table 1. Mean Scores of Pavers

Material	Brand	Mean Score
Concrete	Checkerblock	2.8472
Plastic	Grass Roads	1.4236
Concrete	Eco Stone	1.4097
Concrete	Turflock	1.2986
Plastic	Rings	1.2778
Plastic	Geoblock	1.0347
Scores based upon 144 evaluations		

Table 2. Mean Score of Turfgrass Varieties

Turfgrass	Mean Score
Common Bermuda	1.9097
'Kentucky 31' Fescue	1.7708
'419' Bermudagrass	1.5833
'Rebel II' Fescue	1.4930
'Emerald' Zoysia	1.3194
'Meyer' Zoysia	1.2153
Scores based upon 144 evaluations	

Table 3. Highest and Lowest Rated Paver - Turfgrass Combinations

Paver	Turf Grass	Mean Score
Checkerblock	'419' Bermuda	3.4167
Checkerblock	Common Bermuda	3.2083
Checkerblock	'Kentucky 31' Fescue	3.2083
Geoblock	Common Bermudagrass	0.5830
Geoblock	'Emerald' Zoysia	0.6250
GrassRoads	'419' Bermuda	0.7083

Based upon 24 evaluations

The results of this study are still somewhat preliminary in nature. These plots are due to be re-evaluated in the spring of 1993 to determine the appearance of the plots after exposure over the winter. Further, this study should be repeated to determine if similar results are obtained. Nevertheless, there appear to be major differences in the quality of appearance achieved by the different brands of pavers and varieties of turfgrass.

Future studies are needed to evaluate these pavers and grasses under optimal maintenance conditions. Other studies should attempt to evaluate the pavers under various levels of shading and vehicular traffic in order to simulate actual parking lot conditions. Comparisons of differences in infiltration rates and runoff coefficients also need to be performed.

SUMMARY

For site design professionals like landscape architects, the visual appearance of the completed installation is highly important. If the appearance of a pavement composed of these open-celled pavers does not meet the designer's expectations in terms of appearance, the designer may avoid using that type of product in the future. Because open-celled pavers have the potential to ameliorate many of the adverse impacts of urban development on surface stream water quality, it is imperative that site designers consider their use as an alternative to traditional paving materials. The purpose of this study is to give site designers needed information to help them make those decisions.

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